

Oak Wilt *in Wisconsin*

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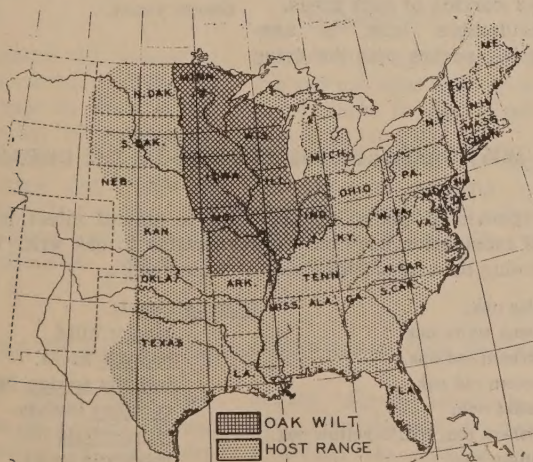
THE WISCONSIN CONSERVATION DEPARTMENT
AND THE UNITED STATES DEPARTMENT OF AGRICULTURE

Oak Wilt *in Wisconsin*

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DURING THE PAST DECADE, oak wilt has spread alarmingly among shade and woodland trees in certain midwestern states. The disease has been reported in Illinois, Indiana, Iowa, Minnesota, Missouri, and Wisconsin. Both state and national warnings concerning its probable spread into new areas have been issued.

The first description of oak wilt as a definite disease was made in 1942. Possibly it has been present for years, but it may have been confused with injury caused by other diseases, drought, or insects. Whether or not it is new does not change its present importance, its rapid spread, and its increasing significance.



Known host range and state distribution of oak wilt

1. The University of Wisconsin, the Wisconsin Conservation Department, and the United States Department of Agriculture cooperating. The Nekoosa Edwards Paper Co., Port Edwards, Wisconsin, has provided land, equipment, and labor. The cover picture was taken by C. S. Moses, Division of Forest Pathology, U.S.D.A., and the others were prepared by Eugene Herrling.

OAKS PREDOMINATE IN SOUTHERN WISCONSIN WOODLANDS

In Wisconsin, oak wilt is most widely distributed and thus most disastrous in the central, southern, southwestern and western parts. There, oaks comprise about 80 per cent of the trees in farm woodlands. The annual reduction both in timber harvest and value is substantial even though immediate salvage of mature wilting trees is possible in the form of lumber, railroad ties, fenceposts, and firewood. Farmers have pointed out many woodlots in which oak trees have been dying in an ever-expanding area for years. Examinations of the remaining trees commonly reveal active oak wilt on the advanced margins of such areas.

Considerable loss in aesthetic value occurs with the dying

of shade trees on lawns around homes. In many instances citizens have paid premium prices for building sites in wooded areas—only to have their oaks killed one by one with oak wilt. As a result, not only do they suffer loss in the value of their property, but also in the costly removal of dead trees. In addition, replacement is expensive, difficult, and many times unsatisfactory.

Of similar concern to the general public is the widespread and unsightly dying of oaks in parks. In Devil's Lake State Park, for example, from 50 to 75 oaks have been removed annually during recent years.

MOST OAKS SEEM SUSCEPTIBLE TO THE DISEASE

All species of oak so far subjected to natural infection or tested by artificial inoculation have proved susceptible to oak wilt. These include the following oaks commonly found in Wisconsin:

White oak.

Swamp white oak.

Northern red oak.

Eastern red oak.

Scarlet oak.

Northern pin, Hill's yellow oak.

Shingle oak.

Bur oak.

Chinquapin oak.

Pin oak.

Black oak.

Quercus alba L.

bicolor Willd.

borealis Michx.

borealis maxima (Marsh.) Ashe

coccinea Muench.

ellipsoidalis Hill

imbricaria Michx.

macrocarpa Michx.

muehlenbergii Engelm.

palustris Muench.

velutina Lam.

Other North American species reported to be susceptible include:

Southern red oak, Spanish oak.	<u>Quercus</u> <u>falcata</u> Michx.
Swamp red oak.	<u>falcata</u> var. <u>pagodaefolia</u> Ell.
Gambel oak.	<u>gambelii</u> Nutt.
Oregon white oak.	<u>garryana</u> Dougl.
	<u>hemisphaerica</u>
Turkey oak	<u>laevis</u> Walt.
Laurel oak.	<u>laurifolia</u> Michx.
Blackjack oak.	<u>marilandica</u> Muench.
Chestnut oak.	<u>montana</u> Willd.
Water oak.	<u>nigra</u> L.
Willow oak.	<u>phellos</u> L.
Basket oak, Swamp chestnut oak.	<u>prinus</u> L.
English oak.	<u>robur</u> L.
Shumard oak.	<u>shumardii</u> Buckl.
Texas red oak.	<u>shumardii</u> var. <u>texana</u> (Buckl.) Ashe
Post oak.	<u>stellata</u> Wangerh.
Cork oak.	<u>suber</u> L.
Live oak.	<u>virginiana</u> Mill.

In Wisconsin, the disease is more severe on trees of the red oak group than on white or bur oaks. Moreover, in many areas where the disease has moved through a mixed stand, only the white and bur oaks remain.

These green escapes are quite conspicuous either in

wilted woodland areas of decaying red oak skeletons or in lawn areas where the dying red oaks have been removed.

No correlation has appeared between the severity of the disease or its rate of spread and differences in soil, site, age, or size of trees.

SYMPTOMS OF THE DISEASE ON DIFFERENT OAK SPECIES

Red and Black Oaks. The first symptom is a slight curling and dull paling of the older leaves, usually near the top of the tree or towards the tips of lateral branches.

Affected leaves gradually become bronze to brown progressively from the tip or margins toward the base. The mature

leaves remain relatively stiff all during symptom development. Generally the swollen base of the petiole becomes dark.

The affected leaves may fall during any of the symptom stages. Thus, it is often possible to find specimens of all stages among the leaves on the ground.

Property owners, although unfamiliar with the early leaf symptoms, invariably are struck by the premature defoliation which necessitates repeated raking of leaves under infected lawn trees. On the other hand, defoliation may be slight and dead leaves may remain on the dead tree for some time.

In many cases, as the wilting of the original set of leaves becomes complete, sucker growth in the form of dense clusters of large, succulent leaves appears on the trunk and larger branches. Before long, however, this new growth in turn wilts and dies.

These leaf symptoms progress very rapidly over the entire crown of the tree, commonly affecting the lower branches last. Usually discoloration, dying, and defoliation of the leaves are complete within a few weeks.

Property owners often insist that their diseased trees cannot be dead, since only a week or so ago the tree was perfectly healthy, green, and thriving. Actually, examination of the annual rings indicates normal growth of the tree to the time of its death.

The external foliage symptoms may or may not be accompanied by brown to black discoloration in the outer annual ring. Peeling back the bark on twigs and branches may reveal either diffuse tanning, stippling, or intermittent streaking. However, this symptom should not be confused with discoloration due to other causes.

All symptom stages have been found from the latter part of May throughout the summer until late September when natural autumn coloration masked the leaf symptoms.

Trees of the red oak group usually die during the same summer in which the first symptoms appear, but occasionally an infected tree may live over winter.

In such cases, the larger branches will leaf out partially the following spring, only to die soon afterwards. No tree of the red oak group has been known to recover. Stump sprouts from wilted trees likewise die so that normal regeneration is prevented.

White and Bur Oaks. The symptoms on white and bur oaks differ somewhat from those on black or red oaks. In the white oak group, the leaf symptoms are much more localized than in the red group.

Usually an entire tree does not wilt at once. Twigs with dead and dying leaves often are scattered throughout the crown. Some branches show leaf symptoms while others remain outwardly healthy throughout the season. Moreover, the withered, dead leaves tend to remain on the trees so that the leaf fall is seldom as heavy as that in the red oak group.

Brown streaking in the sapwood has been observed more commonly in this group. Most trees show dieback of the upper branches to varying degrees so that even-

tually a "stagheaded" appearance results. Twig dieback and general stagheading, however, may be due to other causes.

Since symptom development is relatively slow in the white and bur oaks, infected trees may survive over a period of years. Moreover, trees frequently appear perfectly normal for one or more

seasons following original infection except for the dead branches killed in previous seasons. For this reason, many people insist on allowing infected bur and white oaks to remain, although they conscientiously remove the obviously dying red and black oaks.

A FUNGUS CAUSES OAK WILT

The oak wilt disease is caused by a fungus named *Chalara quercina* Henry. Isolation in culture has been made from practically all 1- to 2-year-old vascular tissue in an infected tree which recently bore wilting leaves and on which the twig tissue was still alive.

The fungus grows on malt extract agar and other common laboratory media. It produces tiny spores inside the tips of fertile hyphae. These spores develop in enormous numbers. After they are placed in a tree through wounds into the vascular tissue, wilting may appear rapidly. Symptoms may follow early summer inoculations within a month or two.

Once infection has taken place, the spread of the fungus inside the tree is very rapid. Both mycelia and spores have been observed in the vessels. In the case of black and red oaks, the organism is found distributed throughout the tree at the time the first symptoms appear.

The fungus lives from one season to the next in infected trees. It may persist in the roots of red and black oaks for at least a year and for a much longer time in the crown of white and bur oaks. Even in the twigs of felled trees, the organism may remain alive for several months.

LOCAL AND DISTANT TRANSMISSION

Oak wilt spreads in at least two different ways. One is a distant type of spread whereby the disease "jumps" anywhere from a few hundred yards to over a mile into previously healthy areas.

How this happens remains to be discovered. Among the possible vectors suspected are birds (such as woodpeckers and sapsuckers), various insects, and rodents (such as squirrels).

A second type of spread is the progressive movement in local areas from diseased to adjacent healthy trees. Ordinarily, starting from a single infected tree, the disease gradually invades an oak stand in a more or less concentric pattern.

After a few years an active wilt area contains dead and decaying skeletons at the center; this is surrounded next with recently killed trees with loosening bark; finally it is bordered by trees in various stages of wilt.

This latter tree-to-tree type of local spread has been studied intensively in Wisconsin. For some time, disease transmission through roots has been suspected. The subsequent dying of nearby trees following injection of poisons into selected individuals has given

support to this idea. Washing and digging out of tree root systems have revealed abundant and wide-spread natural grafting of oak roots.

Water, dyes, and spores of the oak wilt fungus readily move through these grafts. The movement of dyes and poisons between trees is readily traced by means of the characteristic discoloration.

Moreover, the fungus causing oak wilt has been isolated from both sides of grafts connecting diseased and "healthy" trees. As a result of such grafting, trees in a dense stand may be interconnected. Normally, such unions can benefit the tree community. But they are harmful when oak wilt strikes. Through these underground channels the fungus has direct "pipelines" from tree to tree.

NEPCO BOYS' CAMP INJECTION PLOT

JUNE 1947
○ = BLACK OAK
□ = BUR OAK
● = DISEASED 1946
⊙ = INJECTED 1947
○ = HEALTHY

15 ft.

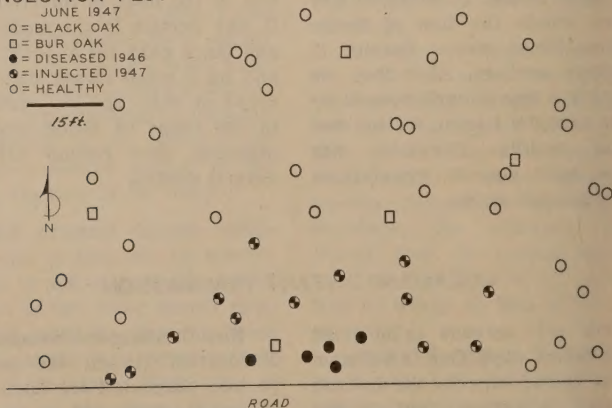


Diagram of an experiment to control oak wilt in a local area by poisoning healthy trees adjacent to wilting trees

POSSIBLE MEANS OF CONTROL

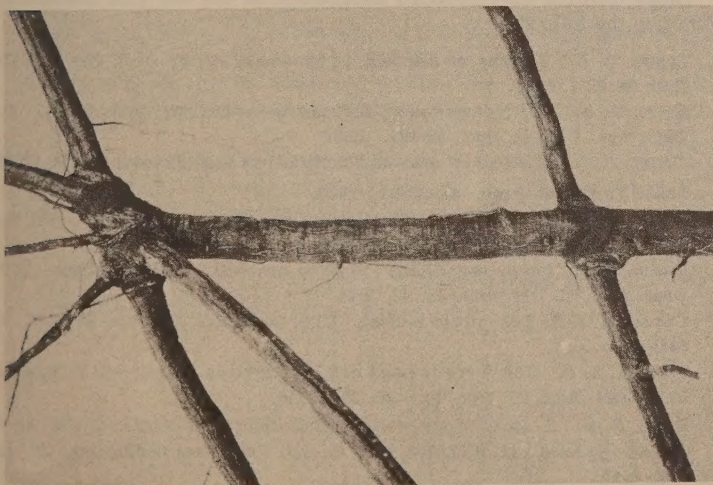
At present, no certain method of controlling oak wilt is known. However, with the discovery of the extensive root grafting in oak stands and the passage of the fungus through these connections, two possible methods of local control have appeared. The method used on an experimental basis in 12 plots in southern Wisconsin depended primarily on the value of the trees.

In woodland areas where individual trees were of relatively low value, poisoning healthy trees bordering the wilted area was tried. This method has prevented further local spread for three years in six experimental plots.

For lawn and park areas where individual trees are of very great value, the severing of all root connections between wilting and healthy trees has been tried.

The results of trenching between trees in seven experimental plots are still to be determined. No wilt has crossed such barriers in one year, although a longer time is necessary to determine its effectiveness.

Certain sanitary measures have retarded the progress of the disease in some wilt areas. In eleven study plots, careful and complete removal of all dead and dying trees followed in subsequent seasons with the immediate removal



Natural grafts underground between the roots of two black oaks.

of any newly wilting trees has reduced the rate of disease spread.

So far, in four plots, this latter method appears to have eradicated the disease. Successful control has been reported where not only have wilted trees been removed, but also healthy trees bordering the wilt area. Grubbing out the stumps and the larger roots and burning them together with all brush give an added precaution.

On the other hand, any delay in the removal of wilting trees, such as postponing until winter,

greatly reduced the chances of success. Such a program, though drastic, may have to be continued conscientiously for several years.

Since the wilt symptoms on white and bur oaks are limited to a few isolated branches, careful and rigorous pruning of all wilting branches has been reported to prolong the life of an occasional tree. How dependable this may be has yet to be determined. Meantime, infected branches on bur and white oaks are recognized as possible sources of inoculum.

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